National Park Service
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Natural Resource Stewardship and Science

# Interim Inventory and Assessment of Abandoned Mineral Lands in the National Park System

Natural Resource Technical Report NPS/NRSS/GRD/NRTR-2013/659











ON THIS PAGE
Skidoo Mill, Death Valley National Park (NPS photo)

ON THE COVER
From upper left to bottom right: headframe over inclined shaft at Duchess Mine, Capitol Reef National Park; Kennecott Mill, Wrangell-St. Elias National Park and Preserve; Stone Cliff Coal Mine, New River Gorge National River; open stope at Skidoo Mine, Death Valley National Park (NPS photos)

# Interim Inventory and Assessment of Abandoned Mineral Lands in the National Park System

Natural Resource Technical Report NPS/NRSS/GRD/NRTR-2013/659

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# Executive Summary

This report presents the interim results of a System-wide National Park Service (NPS) inventory and assessment of its Abandoned Mineral Lands (AML) conducted from fiscal year (FY) 2010 through FY 2012. This project has two primary objectives:

- Complete a comprehensive inventory of AML sites in units of the National Park System that categorizes high, medium, and low priority mitigation needs; and
- Estimate the resources needed to address priority issues with NPS AML features using a consistent, credible approach.

By addressing these two main objectives, this report responds to key issues raised by the Office of the Inspector General (OIG) in its July 2008 Audit Report: Abandoned Mine Lands in the Department of the Interior (DOI 2008). It also responds to the NPS Director's October 2, 2008, memorandum, which, in response to the OIG audit, directed regional and associate directors to update the NPS AML inventory and to identify the funding needed to address priority NPS AML features.

To date, 23,182 AML features have been identified in 129 units of the National Park System. Approximately 80% of the features are located in the Pacific West Region's southern California desert parks, but all seven NPS regions have AML features. Commodities extracted vary regionally but generally include precious metals, base metals, and industrial minerals in the Alaska, Intermountain, and Pacific West Regions; uranium, oil, and gas in the Intermountain Region; and coal, oil, and gas in the Midwest, Northeast, and Southeast Regions. All regions have sand, gravel, and rock quarries. AML features are vestiges of a time when reclamation was not required by federal and state laws and policies, and many pose serious safety issues and resource impacts. Of the 23,182 features inventoried, 1,341 (5.8%) have received long-term treatment, 2,869 (12.4%) are in need of treatment, and the remainder, 18,972 (81.8%) have been inventoried to characterize each site but do not need treatment.

The total estimated cost to remediate the 2,869 AML features is $55.6 million. There are 2,435 features in the high priority category that will cost approximately $44.9 million to remediate. Medium priority sites include 218 features that will cost approximately $7.5 million to remediate. Low priority sites include 216 features that will cost approximately $3.2 million to remediate.

The inventory of NPS California units is scheduled for completion in late 2013. The current California parks inventory is just over 50% complete, and includes 14,428 features, 1,390 of which require mitigation at an estimated cost of $10.2 million. Those data are included in this report. Completion of the California inventory in 2013 will add additional features and costs to the Service-wide inventory. Upon completion of the California AML inventory, the NPS will update the data and analyses and issue a final AML Inventory & Assessment Report. The NPS is issuing this interim report for AML remediation planning purposes.

## Acknowledgements

We wish to acknowledge the contributions of many individuals whose assistance was invaluable to the field inventory and assessment effort, and to production of this report.

In particular, the members of the NPS Abandoned Mineral Lands Advisory Committee (AMLAC) coordinated park inventories, provided technical expertise, and reviewed work products. They include Linda Stromquist of the Alaska Region, Linda Dansby of the Intermountain Region, Chris Holbeck and Leo Acosta of the Midwest Region, Chris Stubbs and Diane Pavek of the National Capital Region, Andy Steel of the Northeast Region, Bob Bryson of the Pacific West Region, and Tom Blount and Todd Knoedler of the Southeast Region.

Support of numerous park staff in each of the 129 NPS units that have AML was invaluable for field inventory coordination and data input.

Data management was coordinated by Pascha Enzi and Nate Irwin. Report graphics were produced by Philip Reiker. Larry Beal and Paul Rothgery of the NPS Denver Service Center provided cost estimation guidelines and administered the AML inventory contract for the three eastern regions and portions of Pacific West Region. The field inventory for California NPS units was conducted by David Tibor and Jon Mistchenko, with data coordination provided by Sarah Reeves. Copyediting and layout services were provided by Schatz Publishing Group.

Finally, we thank our panel of subject-matter experts who provided peer review of this report: Mike Garner, Mark Mesch, Sara Newman, and George Stone.


## Acronyms

| | |
|---|---|
| AKR | NPS Alaska Region |
| AML | Abandoned Mineral Lands |
| AMLAC | Abandoned Mineral Lands Advisory Committee |
| ARRA | American Recovery and Reinvestment Act of 2009 |
| BLM | Bureau of Land Management |
| DOI | Department of the Interior |
| IMR | NPS Intermountain Region |
| FMSS | NPS Facilities Management Software System |
| FY | Fiscal Year (federal government fiscal year is October 1 through September 30) |
| MWR | NPS Midwest Region |
| NCR | NPS National Capitol Region |
| NER | NPS Northeast Region |
| NPS | National Park Service |
| OIG | Office of the Inspector General, Department of the Interior |
| PUF | Polyurethane Foam |
| PWR | NPS Pacific West Region |
| SER | NPS Southeast Region |
| SERI | Society for Ecological Restoration International |
| USGS | U.S. Geological Survey |

# Terms

| | |
|---|---|
| AML | Abandoned Mineral Lands (AML) are lands, waters, and surrounding watersheds that contain facilities, structures, improvements, and disturbances associated with past mineral exploration, extraction, processing, including oil and gas development, and transportation operations for which there is no nonfederal owner or viable responsible party. |
| Ecological Restoration | The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. The goals of restoration are the re-establishment of the pre-existing biotic integrity in terms of species composition and community structure. (Society for Ecological Restoration International (SERI), 2004 ) |
| Features | Individual elements of an AML site, such as vertical shafts, adits, open stopes, open pits, highwalls, and prospects; structures such as headframes, mills, wellheads, and storage facilities; landform modifications such as access roads, drainage diversions, and drill pads; and piles of ore, protore (marginal-grade ore), waste rock, soil stockpiles, and hardrock or placer tailings. For a detailed listing of AML features and their definitions, see appendix A. |
| Mitigation | Any action intended to avoid, reduce, or eliminate hazards or environmental damage. (SERI, 2004) This includes gating, plugging, and reclaiming an AML site or feature that requires remedial action. Many programs use this term to convey only temporary remedial measures such as posting warning signs or installing fencing, but throughout its history, the NPS AML Program has used the broader definition for mitigation. |
| NPS Unit | A distinct area of land or water set aside for protection by Congress as part of the National Park System. Included in the NPS are designations such as national park, national monument, national historic site, national preserve, national recreation area, and national river. |
| National Park System | The system of lands comprised of 399 individual NPS units as of the date of this report. The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. |
| Reclamation | Stabilization of the terrain, assurance of public safety, aesthetic improvement, and usually a return of the land to what, within the regional context, is considered to be a useful purpose. (SERI, 2004) |
| Rehabilitation | The reparation of ecosystem processes, productivity, and services. (SERI, 2004) |
| Remediation | Similar to mitigation; remediation always implies more permanent measures taken to avoid, reduce, or eliminate hazards or environmental damage. This includes "treatments" such as gating, plugging, reclaiming, and long-term water treatment. |
| Revegetation | Establishment of one or more plant species. Reclamation projects that are more ecologically based, including revegetation qualify as rehabilitation or restoration projects. (SERI, 2004) |
| Sites | Lands, waters, and surrounding watersheds that contain facilities, structures, improvements, and disturbances associated with past mineral exploration, extraction, processing, and transportation operations. |
| Treatment | A specific remedial measure. (See "Remediation") |

**Also, see chart and diagram in appendix A: NPS AML feature types and descriptions.**

# Introduction

This report presents the interim results of a System-wide National Park Service (NPS) inventory and assessment of its Abandoned Mineral Lands (AML)[1], conducted from fiscal year (FY) 2010 through FY 2012. This project has two primary objectives:

- Complete a comprehensive inventory of AML sites in units of the National Park System that categorizes high, medium, and low priority mitigation needs; and
- Estimate the resources needed to address priority issues with NPS AML features using a consistent, credible approach.

By addressing these two main objectives, this report responds to key issues raised by the Office of the Inspector General (OIG) in its July 2008 Audit Report: Abandoned Mine Lands in the Department of the Interior (DOI, 2008). The OIG report found that there is a substantial workload in national parks to address hazards and reclamation issues, and that the NPS needs to provide an updated assessment of program funding needs.

This report also addresses direction from the NPS Director's October 2, 2008, memorandum to regional and associate directors, entitled Mitigating High-Risk Abandoned Mine Land Features (Bomar 2008). This memorandum, written in response to the 2008 OIG report, directed the NPS to update the NPS AML inventory and to identify the funding needed to address priority NPS AML features.

This AML inventory and assessment report presents the results of a three-year coordinated effort by the National Park Service Washington Office, Natural Resources Stewardship and Science Directorate, Geologic Resources Division, the NPS Abandoned Mineral Lands Advisory Committee (AMLAC, representing all seven NPS regions), the NPS Denver Service Center, and the 129 parks known to have AML sites within their boundaries.

Inventory of the California NPS units is underway under a contract with the California State AML Unit, funded through the American Recovery and Reinvestment Act of 2009 (ARRA). The California data collected to date are included in this interim report and it is estimated that the California inventory is approximately 54% complete.

The NPS is issuing this interim report to highlight the large number of high priority sites in need of remedial action and in order to proceed with AML Program planning. When the California inventory is complete in late FY 2013, the NPS projects that AML features in California parks may account for as many as 80% of the System-wide AML features. Upon completion of the California ARRA AML inventory, the NPS will update the data and analyses and issue a final AML Inventory & Assessment Report.

The NPS AML Program increases visitor awareness, appreciation, and safety while protecting park resources, and thereby complies with the NPS mission: "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (NPS 1916 Organic Act).

[1] The NPS AML program includes features from all types of mineral development, including oil and gas. Therefore, the NPS uses the term "Abandoned Mineral Lands."

# Background

## Abandoned Mineral Lands in Parks

Historically, mining and oil and gas companies have explored for and extracted a wide variety of metals, minerals, and fossil fuels from lands that are now part of the National Park System. Precious metals, such as gold, silver, and platinum, and base metals such as copper, lead, and zinc have been extracted. Industrial minerals such as talc, limestone, and borates; and aggregate, mostly sand and gravel, have also been mined. Coal mining has occurred on parklands. Oil and gas development has occurred in over a dozen park units.

Most mineral commodities have been developed on NPS lands in the distant past. Abandoned sites and features are remnants of these activities. Mining and oil and gas sites were abandoned by their original operators at a time when reclamation was not required by federal and state laws or regulations. Now, reclamation prior to abandonment is required by agency regulations that implement federal laws such as the Mining in the Parks Act of 1976, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. Individual state laws and regulations also require reclamation but vary from state-to-state.

For a list and description of the kinds of AML features found in the NPS AML inventory, see appendix A. Figure 1 shows the distribution of AML features in the NPS. The most common AML features are adits (horizontal underground openings: 3,191 in the NPS inventory), shafts (vertical or near-vertical underground openings: 1,831 in the NPS inventory), and quarries and pits (1,482 in the NPS inventory).

Most AML features are located in the Pacific West Region – particularly in Death Valley National Park, Mojave National Preserve, and Lake Mead National Recreation Area, where mostly precious metals, base metals, and industrial minerals were extracted. The Intermountain Region has similar commodities, as well as uranium and oil and gas. Abandoned coal mines dominate the Northeast Region. The primary commodities in the Southeast Region are coal, oil, and gas. The AML features in

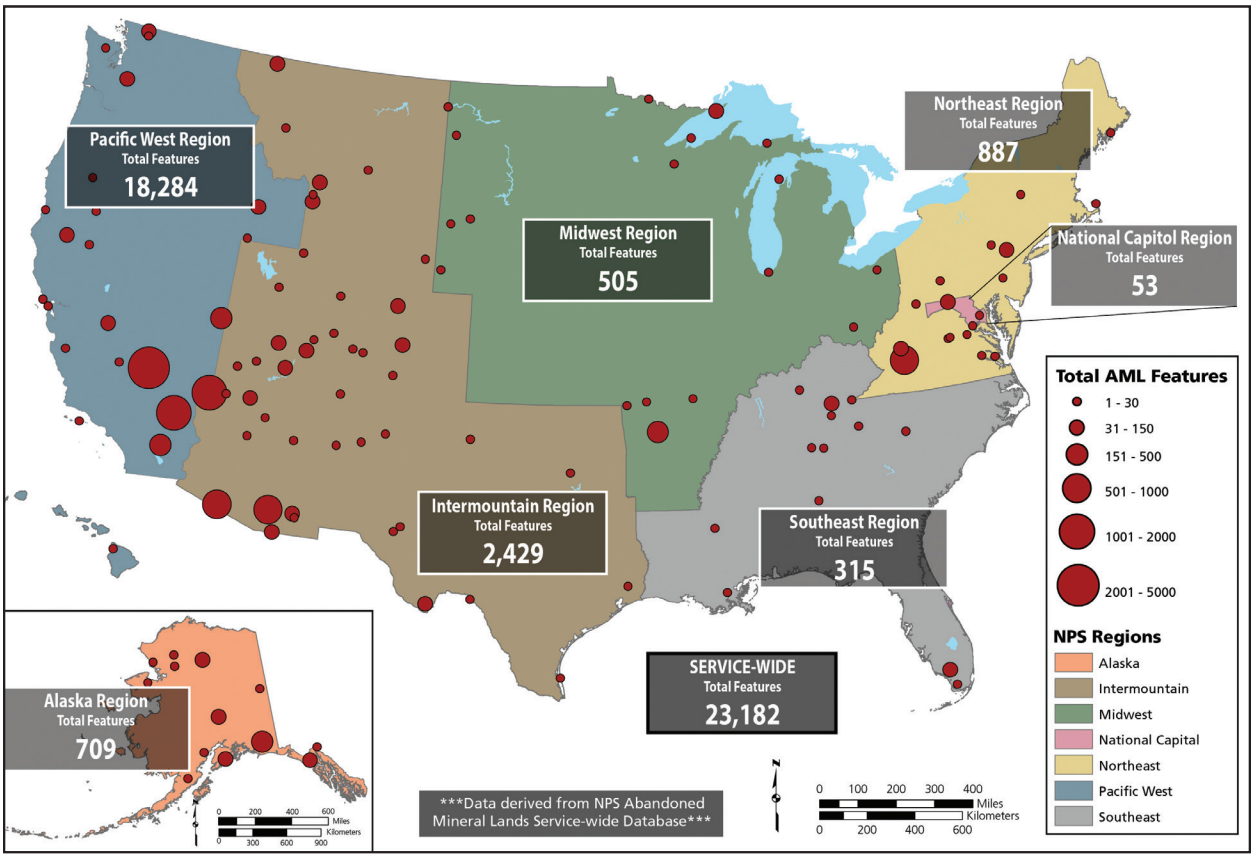



**Figure 1. Distribution of 23,182 AML features in NPS units.**

the Midwest Region were mostly for developing base metals, oil, and gas. The Alaska Region has very significant precious and base metal mines. All regions have sand, gravel, and rock quarries and pits.

## Abandoned Mineral Land Hazards and Impacts

Nationally, the principal cause of deaths at AML sites is drowning in water-filled quarries and pits due to the presence of rock ledges, old machinery, and other hazards that may be hidden beneath the water's surface.[2] The water can be deceptively deep and dangerously cold; and steep, unstable, slippery walls make exiting these features extremely difficult. The second most common cause of AML deaths and serious injuries is from falls into vertical features such as shafts and open stopes at abandoned underground mines. Other risks to human health and safety include deadly gases and radioactive air trapped in confined spaces underground, unstable structures prone to collapse, steep and unstable pit highwalls, and explosives carelessly discarded by mining operations.

Abandoned mineral lands pose a risk not only to humans, but it is widely known that they can also have detrimental effects on the natural environment.[3] Contaminants from the mined materials may be released, affecting air, soil, and water quality, as well as plant and animal health. Interruption of natural drainage by excavations or emplacement of tailings and waste rock piles can lead to extensive erosion and destabilization of the natural topography on-and off-site. An AML site can also affect the natural beauty of an area, although this impact may be an integral part of a historic or cultural landscape in a given park.

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[2] http://www.msha.gov/sosa/fatalstats.asp, http://www.msha.gov/sosa/previousfatalstats.asp
[3] http://www.abandonedmines.gov/ep.html, http://www.osmre.gov/aml/aml.shtm

## AML Inventory and Assessment Methods

Early centralized efforts to inventory AML features began in 1983, when NPS issued a questionnaire to parks requesting basic information about known AML sites. NPS replaced this questionnaire in the early 1990s with a more extensive field inventory form that queried for detailed site location, characterization, and prioritization information needed to develop Service-wide mitigation strategies. Concurrently, the legacy data and new data were compiled in a rudimentary database. That database underwent several modifications until the existing NPS AML database was developed in 2009.

The abandoned mineral land inventory includes sites and features. AML sites include lands, waters, and surrounding watersheds that contain facilities, structures, improvements, and disturbances associated with past mineral exploration, extraction, processing, and transportation operations. AML features are individual elements of an AML site, such as vertical shafts, adits, open stopes, open pits, highwalls, and prospects; structures such as headframes, mills, wellheads, and storage facilities; landform modifications such as access roads, drainage diversions, and drill pads; and piles of ore, protore, waste rock, soil stockpiles, and hardrock or placer tailings. For a detailed listing of AML features and their definitions, see appendix A.

The NPS AML inventory has been systematically prepared by AML specialists[4] using the following methodology:

- Potential abandoned mineral lands are identified on U.S. Geological Survey (USGS) topographic maps, through field investigations, or through previous inventories.
- Park staff or contractors conduct site visits; collect GPS coordinates, measurements, and other data listed in table 1; and photograph the sites and features.
- In this inventory, a mobile field inventory tool is used to edit, update, and transfer AML site and feature information directly to and from the NPS AML database. This streamlines and standardizes all data entry and eliminates potential human errors inherent to transferring data from notebooks and field data sheets to the database.
- Features that are mitigated are noted in the inventory database, and—where data are available—the date, type, and specific costs of the mitigation measures are also included.
- Mitigation specifications and cost estimates are compiled by the team that conducts the field inventory so that they reflect existing, on-the-ground conditions and needs.
- Data are extracted from the AML database using queries that summarize and prioritize the inventory data.

The Service-wide AML database resides on the NPS intranet and is available only to NPS users.[5] Because of the sensitivity of safety and resource information and inclusion of government cost estimates for closures in the AML database, the NPS only posts summary information on its public-facing AML website.[6]

For this inventory and assessment project, AMLAC representatives collaborated to determine how to allocate staff and contractors to conduct the AML inventory and assessment project in their respective regions. As a result, they used multiple approaches to gather the inventory data, depending upon the availability, capabilities, and expertise of park and regional staff. Following is a summary of how each region conducted its AML inventory:

- Northeast , National Capital, Southeast, and the Pacific West Region outside of California and Nevada NPS Units used a contract administered through the NPS Denver Service Center.
- Alaska and Midwest regions, Great Basin National Park, Lake Mead National Recreation Area, and the Nevada portion of Death Valley

[4] An AML specialist is a person trained in some aspect of the natural sciences with a solid working knowledge of exploration and mining methods, equipment, and impacts. Survey teams usually have several members, each with their own area of expertise.

[5] http://insidemaps.nps.gov/, available only to those inside the NPS firewall with editing rights.

[6] http://nature.nps.gov/geology/aml, available to the public.

National Park inventoried their AML resources with regional and/or park staff, sometimes assisted by term and seasonal employees, and a variety of contracts and/or cooperative agreements with local agencies.

- Intermountain Region used two approaches to complete its inventory. Contractors completed inventory and assessment at 300 AML sites in 17 parks, which included assessing their historical significance. Also, park staff reviewed, updated, and collected new data throughout the region.
- Pacific West Region California NPS Units have been, and will continue to be inventoried through FY 2013 under a separate ARRA-funded cooperative agreement with the State of California Department of Conservation, Office of Mine Reclamation, Abandoned Mine Lands Unit.

**Table 1. Data collected for NPS AML inventory**

| CATEGORY | FIELDS IN DATABASE |
|---|---|
| SITE -SPECIFIC | |
| General | NPS region, NPS park code, site name, site type, state, county, congressional district, watershed, site acres, land ownership status, administrative use*, NPS Facilities Management Software System (FMSS) location ID, FMSS asset priority index, FMSS facility condition index, CERCLIS #, EDL #, general site notes |
| Geologic Resources | general commodity, specific commodity, geology notes |
| Natural Resource Impacts | natural resource impacts significant*, effluent*, water pooling*, water running through tailings*, mineral staining on soils/rock*, sediment transport to surface waters*, vegetation health, total waste rock volume, visibility to visitors, other impacts, natural resource impact notes |
| Cultural Resources | cultural resource values significant*, National Register listing or nomination*, Cultural Landscape designation*, eligible for National Register listing*, site interpreted (signs/pamplets)*, cultural values notes |
| FEATURE-SPECIFIC | |
| Identification / Status - General | NPS Service-wide identification code, park-specific identification code, feature type, action required*, data source, latest revision date, general feature notes |
| Access | access method, distance from drivable road, distance from established path, published information*, designated wilderness*, evidence of visitation, access notes |
| Geographic Description | USGS quadrangle map name, latitude north (NAD83), longitude west (NAD83), elevation, location accuracy, GPS date, slope aspect, within park boundary*, UTM north, UTM east, UTM zone, meridian, township, range, section, quadrant |
| Dimensions | dimension X (width), dimension Y (height), depth, depth unknown*, disturbed area, disturbed area length, disturbed area width |
| Biological Resources | significant biological resources*, threatened/endangered species present*, other species of concern*, bat presence/evidence*, biology notes |
| Hazards | hazards in need of mitigation*, debris present*, highwall present*, rockfall hazards present*, falling hazards*, flooded or evidence of previous flooding*, explosives present*, contaminated air documented*, subsidence features present/potential*, underground fire/evidence*, hazardous substances present*, hazard notes |
| Mitigation Required - Specific | temporary safety method required, mitigation option 1, option 1 estimated cost, option 1 cost estimate year, mitigation option 2, option 2 estimated cost, option 2 cost estimate year, NPS Project Management Information System number, FMSS asset ID, mitigation required notes |
| Mitigation Completed - Specific | recovered naturally*, temporary safety method used, date of temporary safety measure, long-term mitigation technique used, date of long-term measure, mitigation cost, funding source, mitigation agent, partners used, mitigation complete notes. |
| Sample and Ranking Data | water sample*, effluent pH, background pH, water contamination*, soil sample*, soil contamination*, contamination notes, hazard danger rating (0-5), workings extensive*, access difficulty rating (0-5), resource importance rating (4/2/0), resource impacts severity rating (4/2/0) |
| Monitoring | monitoring date, monitoring observations |
| * Fields evaluated by Yes/No/Unknown | |

# Mitigation Techniques for AML Features

During the AML inventory, a preferred mitigation option and associated cost for each feature that requires mitigation was developed. Treatment of large, contaminated AML sites can be expensive; therefore, NPS AML mitigation to date has focused on long-term closures of the most hazardous features or temporary closures to mitigate hazards until funding is available for long-term remediation such as gates or reclamation. If the hazard is particularly critical or if the resources are sensitive or severely damaged, park superintendents may close access to an AML site under an administrative order until the safety hazards or resource impacts have been remediated. Mitigation measures used to address AML risks vary depending upon site conditions, access, and mitigation needs for a given feature. Following is a brief list of AML mitigation techniques typically used at NPS AML sites:

- **Signs** used to prohibit access at AML sites with public safety hazards (figure 2)
- **Fences** ranging from 3-strand wire fences to chain-link fences (figure 3)
- **Steel wire or cable nets** for treating large mine openings or areas of potential subsidence (figure 4)
- **Earthen backfills** to fill open voids; often preferred when wildlife habitat or historic significance are not primary considerations (figure 5)
- **Polyurethane foam (PUF) plugs** used as bases for earthen backfill, enabling a large hole to be plugged with a relatively small amount of material (figure 6)
- **Rock or concrete barrier walls** often used on horizontal mine entrances (figure 7)
- **Plugging** of oil and gas wells (figure 8)
- **Steel gates and grates** with or without lockable hatches to allow access when needed (figure 9)
- **Wildlife-accessible steel gates and cupolas** to allow free movement of important wildlife species such as bats and desert tortoise, with or without lockable bars for human access (figures 10 and 11)
- **Reclamation** to stabilize the terrain and return it to its approximate original contour, assure public safety, provide aesthetic improvement, and usually return the land to what, within the regional context, is considered a useful purpose (figure 12)
- **Removing or neutralizing explosives** (figure 13)




**Figure 2 . Administrative closure sign at Keane Wonder Gold Mine, Death Valley National Park California. The closure was done in 2008 to close the popular and historic mine site when testing revealed high levels of lead and other contaminants in the soils. (NPS photo)**



**Figure 3. Fencing of large open stopes, El Portal Barite Mine, Yosemite National Park, California (NPS photo)**



**Figure 4. Cable mesh over open stull stope, Skidoo Gold Mine, Death Valley National Park, California (NPS photo)**




**Figure 5. Backfill of adit with native rock and soils, Rainy Day Uranium Mine, Capitol Reef National Park, Utah (NPS photo)**




**Figure 6. Polyurethane foam plug and backfill with waste rock in progress (left) and after backfill is completed (right) in adit, Jones Branch Mine 195, Big South Fork National River and Recreation Area, Tennessee/Kentucky (NPS photo)**





**Figure 7. Native rock and masonry wall under construction 15 feet inside adit (left), then backfilled with waste rock to the entrance (right), Jomac Uranium Mine, Glen Canyon National Recreation Area, Utah (NPS photos)**



**Figure 8. Oil and gas well plugging operation, unnamed orphaned well, Big South Fork National River and Recreation Area, Tennessee/ Kentucky (NPS photo)**



**Figure 9. Steel grate installed over vertical shaft, Mariscal Mercury Mine, Big Bend National Park, Texas (NPS photo)**





**Figure 10. Bat cupola installed over vertical shaft, Skidoo Gold Mine, Death Valley National Park, California (left - NPS photo); low-profile bat cupola installed over vertical shaft, Rattlesnake Gold Mine, Mojave National Preserve, California (right – photo courtesy of David Tibor, State of California)**






**Figure 11. Bat gate installed in adit, Monte Cristo Zinc Mine 3, Buffalo National River, Arkansas (left – NPS photo); bat gate with desert tortoise access at Katherine Access Gold Mine, Lake Mead National Recreation Area, Arizona (right – NPS photo)**



**Figure 12. Pit restoration in process (left, taken August 2010) and after completion (right, taken November 2012), to return the land to natural conditions; Sand Creek Gravel Pit 7, Great Sand Dunes National Park and Preserve, Colorado (NPS photos)**




**Figure 13. Dynamite found underground at El Cid Mine, later removed by a certified blaster from the local sheriff's department, Joshua Tree National Park, California (NPS photo)**

# Ranking Methodology for AML Features and Sites

## Prioritization of Individual AML Features

One of the primary objectives of this inventory and assessment project is to prioritize features that require mitigation into high, medium, and low categories. Appendix B includes a description of the ranking criteria used in the current AML inventory, and in NPS AML field inventory work done since the mid-1990s. In this report, AML features that require mitigation are prioritized according to the severity of the safety hazards and the intensity of impacts to natural and cultural resources. Due to the risk of serious accidents at features rated 3 and above, the NPS ranks all features with a hazard rating greater than or equal to 3 as high priorities for mitigation. The results of this ranking system are shown in figure 14. NPS assigns high, medium, and low priority rankings to each AML feature according to the following combinations of Hazard and Resource Impact values:

| | |
|---|---|
| **High Priority:** | Hazard Level of 3, 4, or 5 or Resource Impacts of 4; these AML features are top priorities for mitigation. |
| **Medium Priority:** | Hazard Level of 2 or Resource Impacts of 2. |
| **Low Priority:** | Remaining features that require mitigation. |

## Prioritization of AML Sites

Because AML features are generally clustered together at well defined and often times complex sites, NPS has established a site-level ranking system in addition to individually ranking each AML feature. Important reasons to prioritize and mitigate AML features at the site level include:

- Number of features requiring action – Sites with multiple features tend to attract more visitors, increasing the risk of exposure to safety hazards. Sites with multiple features also are likely to have more resource impacts.
- Cultural resource values – If an AML property is listed on the National Register of Historic Places, the listing is usually comprised of the entire site, including many or all of its features.
- Cost savings – The average cost to mitigate AML features drops substantially when all features at a given site are remediated together, primarily because of reduced overall mobilization costs.
- Less environmental impact – There is considerably less impact on natural and cultural resources when all of the features at a site are mitigated at the same time.
- More efficient planning and compliance – Park planning and compliance are usually done for all features at a given site.

Given these considerations, it is appropriate to treat all of the features requiring action at a site at the same time rather than just those that are highly ranked and then returning later to treat the remaining features. The NPS, therefore, uses a site prioritization scheme in this report, ranking each site according to its highest-ranked feature and then applying the same combinations of Hazard and Resource Impact rankings used to prioritize individual features. During the implementation phase, additional criteria such as site access will be used to rank AML features to determine how to allocate program funding.

# Cost Estimation Procedure for AML Feature Mitigation

Field inspectors estimated mitigation costs for each AML feature using field data and a variety of cost estimation techniques. Where available, comparable costs from nearby and recently completed AML projects were used as proxies. Where no comparable costs were available, inspectors made estimates based on an assessment of required labor, equipment, materials, and travel, with appropriate markups as outlined in appendix D. NPS considers the ranking elements shown in table B-1 (degree of hazard, extent of workings, accessibility, resource significance, and resource impacts) in determining the appropriate mitigation technique and in calculating mitigation costs. Cost estimates may also include pre- and post-closure wildlife surveys, construction monitoring to ensure compliance with plans and specifications, biological and archeological monitoring during project implementation, and project planning and compliance requirements.

# Results

Based on the current AML inventory comprised of 23,182 features, 2,869 features at 931 sites require remedial action, as shown in figure 14 and table 2. High priority sites comprised of 2,435 features will cost approximately $44.9 million to remediate. Medium priority sites (218 features) will cost approximately $7.5 million to remediate. Low priority sites (216 features) will cost approximately $3.2 million to remediate. The total cost for remediation of features requiring action currently in the NPS database is approximately $55.6 million. Figure 15 shows the System-wide prioritization and costs to mitigate all of the AML features requiring mitigation.

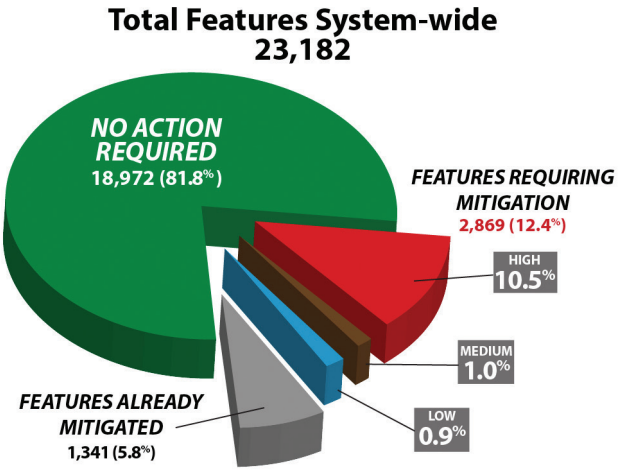



**Figure 14 . Distribution of AML features requiring mitigation, breaking out high, medium, and low priority features.**

**Table 2. Site prioritization results for AML features that require mitigation**

| Priority | Sites | | Features | | Cost | Percentage of Services-wide Features |
|---|---|---|---|---|---|---|
| | # | % | # | % | | |
| HIGH | 626 | 67.2 | 2,435 | 84.9 | $44.9 million | 10.5 |
| MEDIUM | 133 | 14.3 | 218 | 7.6 | $7.5 million | 1.0 |
| LOW | 172 | 18.5 | 216 | 7.5 | $3.2 million | 0.9 |
| TOTAL | 931 | 100.0 | 2,869 | 100.0 | $55.6 million | 12.4 |

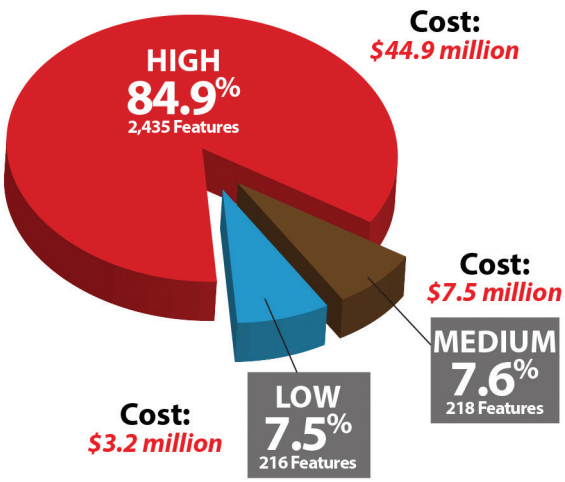



**Figure 15. Costs to remediate high, medium, and low priority AML features, when ranked by site. Percentages relate to number of features to be mitigated.**

The regional ranking of AML sites requiring remediation, their priority and remediation costs, and the number of features that would be mitigated are shown in figure 16 and table 3. The features that require mitigation represent 12.4% of the features that have been inventoried to date. The majority of AML sites and features requiring mitigation fall into the high category, where there is a risk of serious injury or where there is severe environmental or cultural resource damage. Even though the majority of features requiring mitigation are in the Pacific West Region, the data collected in this inventory indicate that each region has significant AML issues where remediation is necessary. See appendix C for a park-by-park summary of remediation priorities and costs.

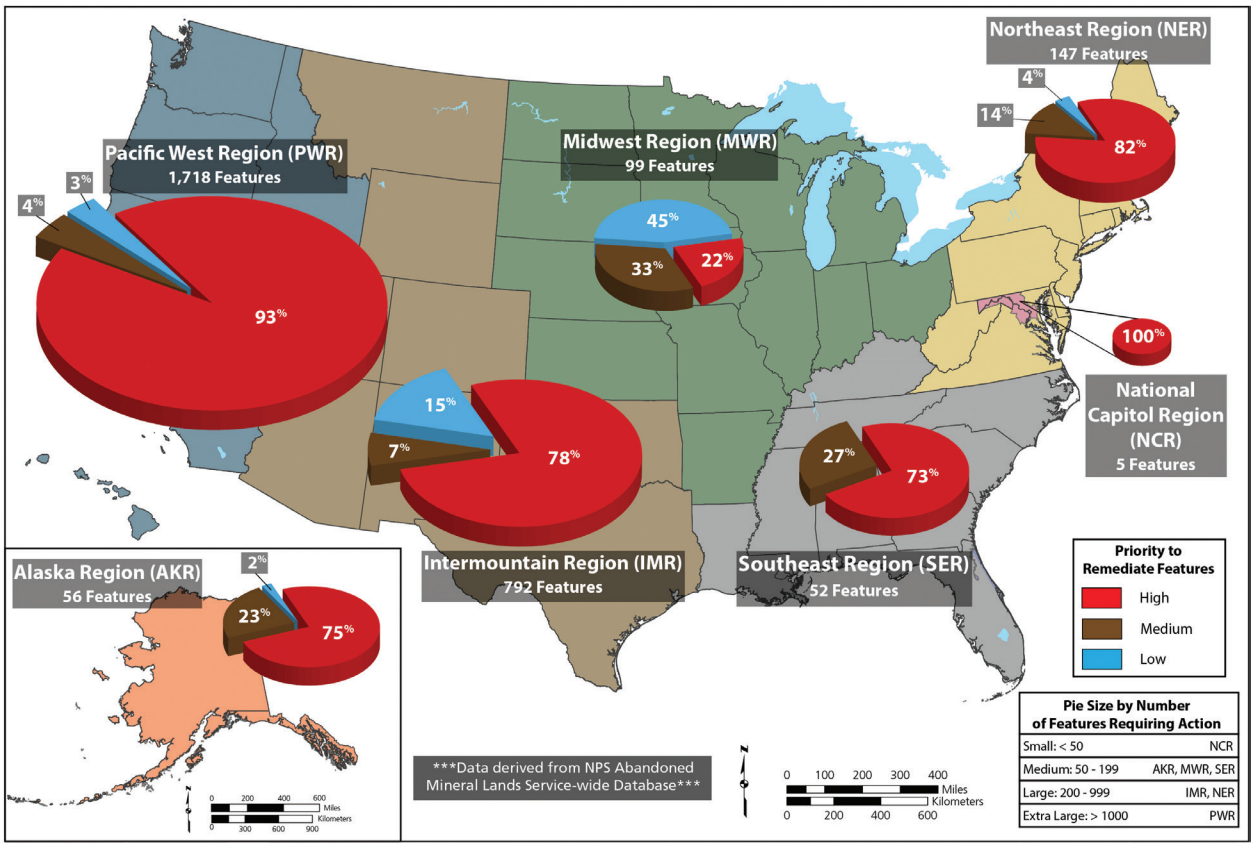



**Figure 16. Prioritization by region of AML features that require mitigation**

**Table 3. Prioritization by region of AML sites and related features that require mitigation, their rankings, and associated costs**

| Region (# NPS units that have AML features) | High | | | Medium | | | Low | | | Total Regional Costs (x $1,000) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sites | Features | Cost (x $1,000) | Sites | Features | Cost (x $1,000) | Sites | Features | Cost (x $1,000) | |
| Alaska (13) | 29 | 42 | 6,342 | 9 | 13 | 2,058 | 1 | 1 | 32 | 8,432 |
| Intermountain (44) | 146 | 614 | 13,886 | 34 | 60 | 3,839 | 109 | 118 | 1,741 | 19,466 |
| Midwest (18) | 5 | 22 | 83 | 18 | 33 | 239 | 21 | 44 | 640 | 962 |
| National Capital (3) | 2 | 5 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| Northeast (15) | 48 | 121 | 901 | 16 | 20 | 131 | 5 | 6 | 57 | 1,089 |
| Pacific West (23) | 379 | 1,593 | 19,943 | 42 | 78 | 797 | 36 | 47 | 716 | 21,456 |
| Southeast (13) | 17 | 38 | 3,690 | 14 | 14 | 434 | 0 | 0 | 0 | 4,124 |
| **Service-wide Totals (129 NPS units)** | **626** | **2,435** | **$44.9 million** | **133** | **218** | **$7.5 million** | **172** | **216** | **$3,186** | **$55.6 million** |

## Completion of California AML Inventory

The AML inventory and assessment for the Pacific West Region's California NPS units, funded through the ARRA, is scheduled to be completed in late FY 2013. The ARRA contract specified that the State of California's AML Unit would inventory and record all features found where mine symbols appear on USGS 7.5-minute topographic maps. To date, they have recorded an average of five AML features for each mine symbol, and have inventoried the land around 54% of the USGS map mine symbols. The current California parks inventory includes 14,428 features, 1,390 of which require mitigation at an estimated cost of $10.2 million. Those data are included in this interim report.

Upon completion of the California inventory in 2013 any additional features and costs will be included in the inventory. Refinements and additions to data for other NPS units are also likely to increase numbers in the Service-wide AML inventory. The NPS will produce a final report summarizing the completed Service-wide AML inventory.

## Literature Cited

Department of the Interior (DOI). 2008. Audit Report: Abandoned Mine Lands in the Department of the Interior. Report C-IN-MOA-0004-2007. July 2008. National Park Service website. http://nature.nps.gov/geology/aml/OIG-DOI_AML_Audit-FINAL-2008-0717.pdf (accessed October 10, 2012).

Bomar, M. A., 2008, Memorandum: Mitigating High-Risk Abandoned Mine Land Features, National Park Service, Washington, DC.

Bureau of Land Management (BLM). 2006. The Cooperative Conservation Based Strategic Plan for the Abandoned Mine Lands Program. Bureau of Land Management website. http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/aml/aml_strategic_plan.Par.41029.File.dat/AMLStrategicPlanIntroduction.pdf (accessed October 10, 2012).

National Park Service, 2011, Cost Estimating Requirements Handbook, http://www.nps.gov/dscw/upload/CostEstimatingHandbook_2-3-11.pdf.

Society for Ecological Restoration International, 2004, The SER International Primer on Ecological Restoration, Version 2, October 2004. http://www.ser.org/resources/resources-detail-view/ser-international-primer-on-ecological-restoration

## Appendices

Appendix A: NPS AML feature types and descriptions

Appendix B: Discussion of AML feature ranking criteria considered for prioritization

Appendix C: Summary AML data by region and park

Appendix D: NPS standard construction approach to estimating AML mitigation costs

# Appendix A: NPS AML feature types and descriptions

**Table A-1. Feature types and descriptions used in NPS AML Inventory**

| NPS Service-wide AML Database – FEATURE TYPES | | | Dimensions as Specified in Database | | |
|---|---|---|---|---|---|
| **CODE** | **FEATURE** | **DESCRIPTION** | **Dim_X** | **Dim _Y** | **Depth** |
| **Underground Excavations** | | | | | |
| AD | Adit | Horizontal (or near-horizontal) entrance to underground mine. No hoisting system was required to transport people and equipment or to extract ore. Easy to walk in and out. | width | height | horizontal distance into mine |
| SH | Shaft | Vertical (or near-vertical) entrance to underground mine. "Cage" hoisting system (mine elevator) was necessary to transport people and equipment and to extract ore. Climbing is required to get out. | short horizontal dimension | long horizontal dimension | vertical distance down shaft |
| IN | Incline | Sloped entrance to underground mine, mined from the surface usually along the dip of a vein or stratigraphic horizon. Sometimes called "decline," or "declined shaft." Steep enough that rail-mounted skip hoist system was necessary to extract ore. Clambering is required to get out. | width | height | slope distance into mine |
| TU | Tunnel | Horizontal (or near-horizontal) underground mine passageway with openings to the surface at both ends. | width | height | horizontal distance through mine |
| OS | Open Stope | Linear opening mined from underground to the surface along the course of a vein or mineralized zone. | short horizontal dimension | long horizontal dimension | vertical/ slope distance down into stope |
| VR | Vent Raise | Vertical (or near-vertical) feature mined from underground to the surface to aid in mine ventilation. Looks identical to a shaft, but there is no waste rock pile nearby since it was not mined from the surface. | short horizontal dimension | long horizontal dimension | vertical/ slope distance into raise |
| GH | Glory Hole | Broad opening mined and collapsed from underground – differentiated from "Shaft" in that it is usually has irregular dimensions and there is no waste rock pile nearby, since it was not mined from the surface. Differentiated from "Subsidence" in that it is completely collapsed, exposing underground workings. | short horizontal dimension | long horizontal dimension | vertical distance down glory hole |
| SU | Subsidence | Any subsidence feature resulting from collapse of subsurface mine workings. Describe in Feature_Notes field. | short horizontal dimension | long horizontal dimension | maximum depth |
| PR | Prospect | Any mined feature, horizontal to vertical, less than 6 feet deep. | (adit or shaft dimensions, as appropriate) | | |
| **Surface Excavations** | | | | | |
| SM | Surface Mine | Hardrock or coal open pit, open cut, or strip mine; rock quarry, sand & gravel pit, cinder pit, borrow pit, etc. | short horizontal dimension | long horizontal dimension | vertical depth |
| HW | Highwall | Vertical or near-vertical wall that results at end of broad excavation into a hillside - may require stabilization/mitigation even if surrounding excavation is not fully reclaimed. Differentiated from steep walls on all sides of an open pit mine, portal area of an underground mine, or steep area uphill from road / bench cut. | width | - | height |
| TR | Trench | Linear surface excavation for conveyance of water, drainage diversion, outcrop exposure, etc. | width | length | depth |

| NPS Service-wide AML Database – FEATURE TYPES (continued) | | | | | |
|---|---|---|---|---|---|
| | | | Dimensions as Specified in Database | | |
| CODE | FEATURE | DESCRIPTION | Dim_X | Dim _Y | Depth |
| **Other Features** | | | | | |
| WR | Waste Rock | (aka "spoil pile," or "spoils." Waste rock pile also called "dump.") Unmineralized rock mined to expose and access an orebody. Can be "overburden" from pit mine that was stripped to get down to the ore zone, or barren rock mined underground to access a vein or other mineralized zone. Distinguishing characteristics are variable rock size and scant mineralization. Waste rock is usually dumped as close to the mine as possible to minimize transportation costs. | short horizontal dimension | long horizontal dimension | height of pile |
| TA | Tailings | At hardrock mine sites, tailings have been ground to a consistent sand or powder grain size to facilitate metal extraction. The potential for residual metals and processing chemicals, as well as fine grain size, make hardrock tailings highly susceptible to erosion and leaching of contaminants into the environment. At placer AML sites, this term refers to coarse rocks and boulders cast alongside stream channels that were dredged for gold or other commodities, whereas finer tailings were most likely washed downstream. Resulting landform is unnatural and difficult to revegetate due to absent soil and sandy components. | short horizontal dimension | long horizontal dimension | height of pile |
| OP | Ore Pile | Abandoned pile of high-grade mineralized rock that was set aside to be processed, but never made it to the mill. Includes "protore," which is mid-grade material that is set aside awaiting better market conditions or processes that would make it economic to process in the future. | short horizontal dimension | long horizontal dimension | height of pile |
| TS | Topsoil Stockpile | Topsoil stockpiled on-site for future use in reclamation phase of the operation. Usually stripped at beginning of operation from areas to be mined or areas to be used for support facilities (e.g., mill site, buildings, and pads for ore and equipment storage). | short horizontal dimension | long horizontal dimension | height of pile |
| RD | Road | Road / mine access bench | width | length | - |
| IM | Impoundment | Impoundment for water, tailings, ore processing solutions, etc. | short horizontal dimension | long horizontal dimension | vertical distance to bottom |
| EM | Embankment | Bank, mound, dike, etc., resulting from site clearing, barricading, or other ground surface modifications. | short horizontal dimension | long horizontal dimension | height of pile |
| BD | Building | e.g., mill, office, shop, dry (clothing/showering facility), residence, etc. | short horizontal dimension | long horizontal dimension | height of building |
| ST | Structure | e.g., headframe, ore storage bin, ore chute, tipple, loadout, pad, foundation for equipment or building, etc. | short horizontal dimension | long horizontal dimension | height of structure |
| EQ | Equipment | e.g., ore car, hoist, trommel, generator, compressor, pressure tank, storage tank, front-end loader, mucker, bulldozer, drill rig, etc. | short horizontal dimension | long horizontal dimension | height of equipment |
| WE | Well | e.g., oil, gas, geothermal, water (including hand-dug wells, which tend to be rectangular, and drilled wells, which a cylindrical). NOTE: For drilled wells, record diamater in feet (e.g., 4" = 0.33 feet). | short horizontal dimension | long horizontal dimension | depth |
| | | | diameter | 0 (zero) | depth |
| HC | Hazmat Cache | Hazardous materials cache that is not associated with another feature (e.g., hazmat stash inside an adit should be entered as Feature_Type = "Adit"). | short horizontal dimension | long horizontal dimension | average height of pile |
| AC | Artifact Concentration | Any pile of historically significant artifacts, e.g., machinery parts, drill bits, core samples, empty food cans. Describe in Feature_Notes field. | short horizontal dimension | long horizontal dimension | average height of pile |
| TP | Trash Pile | Discrete trash pile worthy of separate GPS location - to be distinguished from general debris scattered around a site or feature. Also do not confuse with "dump," which in mining terminology refers to a waste rock pile (mined material that was not sent to a mill). Describe further in Feature_Notes field. | short horizontal dimension | long horizontal dimension | average height of pile |

| NPS Service-wide AML Database – FEATURE TYPES (continued) | | | Dimensions as Specified in Database | | |
|---|---|---|---|---|---|
| **CODE** | **FEATURE** | **DESCRIPTION** | **Dim_X** | **Dim _Y** | **Depth** |
| EC | Explosives Cache | Onsite explosives cache that is not associated with another feature (e.g., not a small adit that is used for an explosives magazine). If explosives are present, make note in Feature_Notes field and describe further in Haz_Notes field. | short horizontal dimension | long horizontal dimension | average height of pile |
| **Left-overs** | | | | | |
| OT | Other | Anything that does not fit above – include description in Feature_Notes field. | (as deemed appropriate) | | |
| UN | Unknown | Use only as a placeholder for legacy data where feature type is not specified and current staff are not familiar with site. Please update next time site is inspected by entering new feature record (with specific feature type identified) into database, then delete "Unknown" feature record. [This feature type does not show on field inventory forms.] | | | |

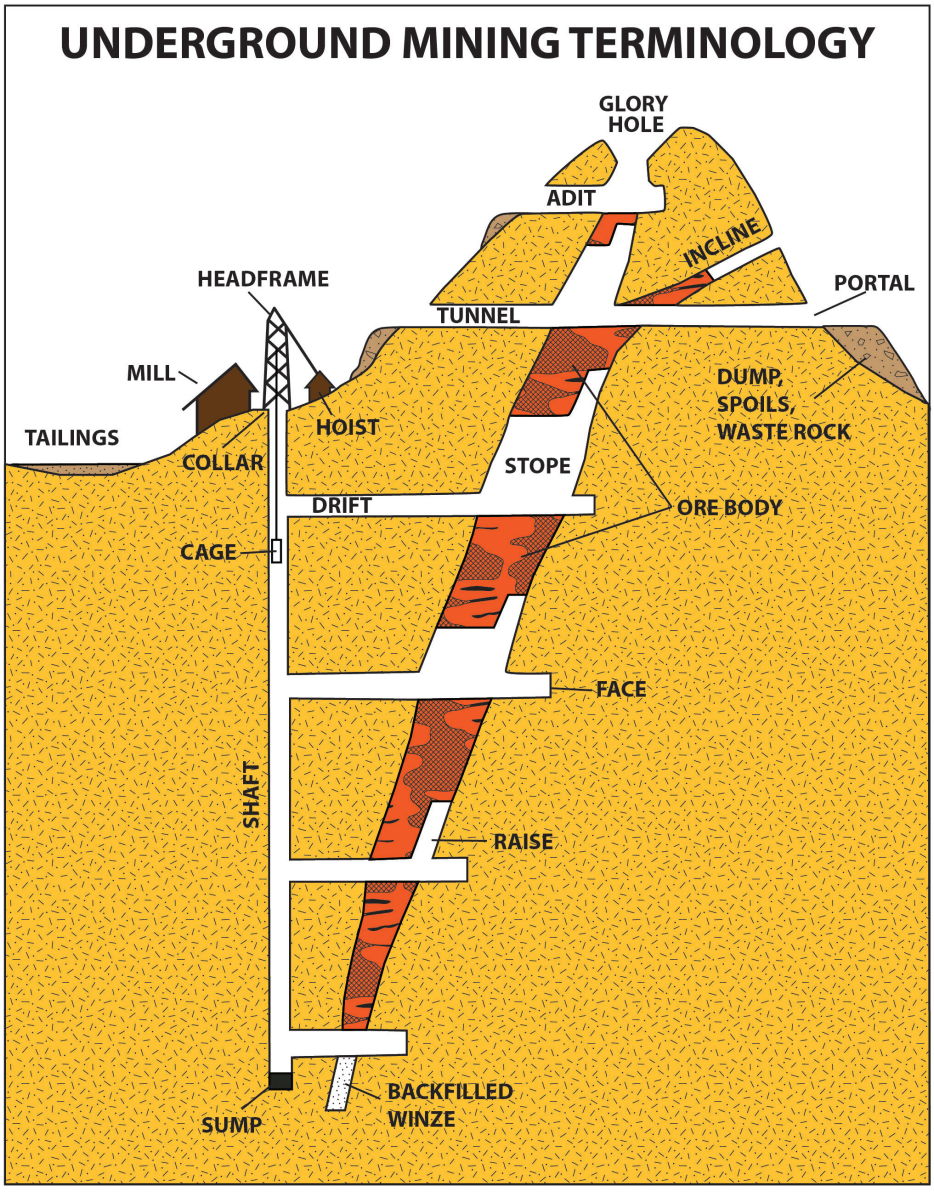



**Figure A-1. Diagram illustrating general mining terminology.**

# Appendix B: Discussion of AML feature ranking criteria considered for prioritization

During the AML inventory, the NPS used hazard, access, resource significance, and resource impacts to develop feature- and site-specific mitigation recommendations, cost estimates, and priorities (see table B-1). These ranking elements are broken out separately so that they can be applied to the specific needs of a project or funding source that focuses on one or more of the elements shown below.

**Table B-1. Criteria used in prioritizing NPS AML features for remedial action**

| NPS AML Program Feature Ranking Criteria | | PRIORITY |
|---|---|---|
| Hazard Rating (possible score: 0 to 5) | | |
| 5 | • Any coal mine<br>• Vertical shafts, winzes, or underhand collapsed stopes > 6'<br>• Irrespirable air<br>• Instantaneous fatal injury could occur due to mine-related hazard | HIGH |
| 4 | • Large unstable structures<br>• Deep pools of water from which it would be difficult to climb out.<br>• Potential fatal injury could occur<br>• Major collapse zones | |
| 3 | • Radiation potential<br>• Large stopes overhead - seemingly stable<br>• Highwalls > 10' drop-off not apparent from above<br>• Serious injury could occur | |
| 2 | • Highwalls > 10' - drop-off apparent from above<br>• Rubble around but rock is generally stable<br>• Moderate injury could occur | MEDIUM |
| 1 | • Minimal injuries could occur like tripping, bumping head, cutting oneself<br>• Highwalls < 10' in area where such drop-offs are common naturally<br>• Minimal injury possible | LOW |
| 0 | • No inherent hazards; no injury potential above normal condition | |
| **Workings Extensive** | | |
| Yes | Over 500 feet of workings or multiple levels | |
| No | Less than 500 feet of workings or single level | |
| **Access Rating (likelihood of visitation - possible score: 0 to 5)** | | |
| 5 | Good road with mine as the specific destination; car accessible | HIGH |
| 4 | Good dirt road, but mine is not specific destination | |
| 3 | Dirt road or path without specific destination; no car access; easy hiking access < 1 mile | MED |
| 2 | Near a road/path (within 1 mile); Easy hike > 5 miles or moderate hike < 5 miles | |
| 1 | > 1 mile from road/path; Moderate hike > 5 miles or hard hike < 5 miles | LOW |
| 0 | Hard hike > 5 miles; site not easily seen | |
| **Resource Significance Rating (possible score: 0, 2, or 4)** | | |
| 4 | Endangered species present or site is listed on National or Local Historic Register | HIGH |
| 2 | Species of concern present or site has significant cultural values | MED |
| 0 | No species of concern present and site has minimal cultural value | LOW |
| **Resource Impacts Rating (possible score: 0, 2, or 4)** | | |
| 4 | Highly elevated contaminants or greatly altered pH in water/soils; High visual impact | HIGH |
| 2 | Moderately elevated contaminants or pH alteration in water/soils; Moderate visual impact | MED |
| 0 | Minimal contaminants or pH alteration in water/soils; Minimal visual impact | LOW |

- Hazard: Possible ratings are 0, 1, 2, 3, 4, or 5 (5 being the most hazardous). For purposes of breaking the analysis into high, medium, and low hazards, break lines were set as follows: high (3-5), medium (2), and low (less than 2).
- Workings Extensive: Possible entries are yes or no. Larger, multi-level mines are more likely to be hazardous, more prone to provide wildlife habitat (especially for bat species), and more likely to be culturally significant.
- Access: Possible ratings are 0, 1, 2, 3, 4, or 5 (5 being the most accessible) based on easier access being more likely to attract visitors. For purposes of breaking the analysis into high, medium, and low accessibility, break lines were set as follows: easy (4-5), moderate (2-3), and difficult (less than 2). This system was set up to rank remote features lower in priority than those that are more accessible. For reasons discussed below, the NPS has decided not to include access in the prioritization process used for this report.
- Resource Values: Possible ratings are 0, 2, or 4 (4 being most important). This rating can be further broken out by cultural and natural resource values based on answers to fields in the site inventory forms under those headings, which yields an additional ranking field.
- Resource Impacts: Possible ratings are 0, 2, or 4 (4 having the most impacts). Impacts usually pertain to natural resources, such as contamination of soils or water quality, but may also pertain to cultural resources, such as impacts to the viewshed at historic sites.

Table B-2 shows the distribution of high, medium, and low rankings for the NPS AML features that require remedial action. NPS added the impacts and resources significance fields to the inventory protocol much later than the hazard and access fields; consequently, some of the legacy data does not include values for these elements. Where the impacts and resource significance fields were left blank, NPS assumes a value of zero.

**Table B-2. System-wide summary of individual AML feature ranking elements for features that require mitigation.**

| Parameter | High | | Medium | | Low | | Features Requiring Mitigation |
|---|---|---|---|---|---|---|---|
| | # features | percent | # features | percent | # features | percent | |
| Hazard (high >=3) | 2,198 | 76.6 | 198 | 6.9 | 473 | 16.5 | **2,869** |
| Impacts | 65 | 2.3 | 286 | 10.0 | 2,518 | 87.8 | |
| Access | 609 | 21.2 | 1,753 | 61.1 | 507 | 17.7 | |
| Resources Significance | 451 | 15.7 | 1,633 | 56.9 | 785 | 27.4 | |

A sorted list of all features' cumulative scores might seem to yield a good scheme for prioritizing projects, but this simple evaluation does not fully take into consideration program priorities, which is why treatment priorities are established ***by site*** in this report (see rationale for ranking by site in the *Prioritization of AML Sites* section in the body of this report).

The percentages in table B-2 show that high priority ratings are mostly due to hazards. Due to the risk of a serious accident, the NPS determined that hazard ratings of 3 and above should be considered a high priority.

Fewer features have associated resource impacts, but those impacts can be very significant and mitigation can be costly, so resource impacts are a top concern in the NPS ranking scheme.

During the AML inventory, accessibility was an important factor considered when ranking individual features. Greater visitation typically occurs at sites that are more accessible; however, many remote NPS AML sites are also popular destinations for park visitors.[7] NPS staffs have observed that even the most remote sites or the deepest parts of underground mines have received significant visitation, as evidenced by trash and graffiti. In many cases, the only access to a remote park area is an old mine road or trail that has a mine site as the final destination. Remote sites pose a greater risk of serious complications and the distance to populated areas increases the complexity and risk of search and rescue operations. For these reasons, the NPS determined that access should not be a major factor in prioritizing features into high, medium, and low priorities for the purposes in this report. However, accessibility will be considered when ranking one site or project against another during project implementation.

Similarly, the NPS determined that natural and cultural resource significance, while important, should not be considered in developing high, medium, and low prioritization in this report. Natural and cultural resource significance rankings developed for the inventory are typically not the results of detailed sampling, site characterization, or studies such as Determinations of Eligibility for listing on the National Register of Historic Places. Rather, these are initial impressions designed to identify features and sites where more detailed assessments are warranted. As more information is gathered, it is likely that more of the features will be placed in the medium and high categories for natural and cultural resources significance.

Based on the OIG report's emphasis on safety and the data in the Service-wide AML database, the NPS has decided that prioritization of AML sites and features should be done using hazards and resource impacts, resulting in the majority of NPS AML features falling in the high category. This ranking scheme is not the same as has been used by other agencies such as the Bureau of Land Management (BLM 2006). After careful consideration, the NPS' mandate to protect resources while providing for visitor use supports the prioritization scheme used in this inventory and assessment project. The following support the NPS ranking methodology:

- The NPS 1916 Organic Act directs the NPS "… to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." This mandate focuses on preservation and visitor use.
- Public access on NPS lands is broadly dispersed in developed and remote backcountry sites.[8] NPS is committed to the safety of park visitors to the greatest extent possible,[9] therefore access is not considered a primary factor in prioritizing sites into high, medium, and low categories for this analysis. Because park visitors go to remote backcountry AML sites, a truly hazardous feature should not be ranked as a medium or low priority just because it is remote.

The rankings provided in this report are for planning purposes only. Flexibility in ranking and project selection will be required during project implementation.

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[7] Anecdotal information from AMLAC, park and regional staff.

[8] Anecdotal information from park and regional staff.

[9] NPS Management Policies 2006, http://www.nps.gov/policy/mp2006.pdf

# Appendix C: Summary of AML data by region and park

**Table C-1. System-wide summary of individual AML feature ranking elements for features that require mitigation.**

| NPS Unit | Features | | | Sites | | | | | | | | | | Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sites and Associated Features Requiring Mitigation | | | | | | | | | |
| | | | | | High | | | Medium | | | Low | | | |
| | Total | Already Mitigated | Mitigation Required | Total | Sites | Features | Cost ($) | Sites | Features | Cost ($) | Sites | Features | Cost ($) | |
| | # | # | # | # | | | | | | | | | | |
| Alaska Region | | | | | | | | | | | | | | |
| Bering Land Bridge National Preserve | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cape Krusenstern National Monument | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Denali National Park and Preserve | 159 | 37 | 10 | 74 | 3 | 5 | 2,471,780 | 3 | 5 | 923,602 | 0 | 0 | 0 | 3,395,382 |
| Gates of the Arctic National Park and Preserve | 54 | 1 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Glacier Bay National Park and Preserve | 46 | 6 | 4 | 23 | 4 | 4 | 182,575 | 0 | 0 | 0 | 0 | 0 | 0 | 182,575 |
| Katmai National Park and Preserve | 18 | 2 | 1 | 11 | 0 | 0 | 0 | 1 | 1 | 350,000 | 0 | 0 | 0 | 350,000 |
| Kenai Fjords National Park | 50 | 12 | 7 | 14 | 2 | 4 | 650,628 | 2 | 3 | 648,001 | 0 | 0 | 0 | 1,298,629 |
| Klondike Gold Rush National Historic Park | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kobuk Valley National Park | 21 | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| Lake Clark National Park and Preserve | 17 | 0 | 3 | 8 | 0 | 0 | 0 | 2 | 3 | 80,042 | 0 | 0 | 0 | 80,042 |
| Noatak National Preserve | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wrangell-St. Elias National Park and Preserve | 298 | 43 | 31 | 83 | 20 | 29 | 3,037,488 | 1 | 1 | 56,636 | 1 | 1 | 32,020 | 3,126,144 |
| Yukon-Charley Rivers National Preserve | 37 | 3 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **13 NPS Units - Alaska Totals** | **709** | **108** | **56** | **256** | **29** | **42** | **$6,342,471** | **9** | **13** | **$2,058,281** | **1** | **1** | **$32,020** | **$8,432,796** |
| Intermountain Region | | | | | | | | | | | | | | |
| Amistad Recreation Area | 3 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 20,000 | 20,000 |
| Arches National Park | 4 | 0 | 3 | 1 | 1 | 3 | 40,000 | 0 | 0 | 0 | 0 | 0 | 0 | 40,000 |
| Aztec Ruins National Monument | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big Bend National Park | 98 | 23 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big Thicket National Preserve | 28 | 0 | 8 | 28 | 7 | 7 | 2,550,000 | 0 | 0 | 0 | 1 | 1 | 250,000 | 2,800,000 |
| Black Canyon of the Gunnison National Park | 13 | 10 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| NPS Unit | Features | | | Sites | | | | | | | | | | Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sites and Associated Features Requiring Mitigation | | | | | | | | | |
| | | | | | High | | | Medium | | | Low | | | |
| | Total | Already Mitigated | Mitigation Required | Total | Sites | Features | Cost ($) | Sites | Features | Cost ($) | Sites | Features | Cost ($) | |
| | # | # | # | # | | | | | | | | | | |
| Black Canyon of the Gunnison National Monument | 20 | 2 | 6 | 18 | 0 | 0 | 0 | 2 | 2 | 4,500 | 4 | 4 | 10,500 | 15,000 |
| Bryce Canyon National Park | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Canyonlands National Park | 62 | 11 | 22 | 21 | 3 | 5 | 22,000 | 6 | 13 | 57,000 | 4 | 4 | 30,000 | 109,000 |
| Capitol Reef National Park | 62 | 20 | 15 | 14 | 2 | 3 | 13,500 | 6 | 11 | 25,980 | 1 | 1 | 5,000 | 44,480 |
| Carlsbad Caverns National Park | 11 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chickasaw National Recreation Area | 2 | 0 | 2 | 2 | 2 | 2 | 140,000 | 0 | 0 | 0 | 0 | 0 | 0 | 140,000 |
| Chiricahua National Monument | 13 | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Colorado National Monument | 10 | 1 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coronado National Memorial | 65 | 59 | 5 | 8 | 2 | 4 | 18,000 | 0 | 0 | 0 | 1 | 1 | 5,000 | 23,000 |
| Curecanti National Recreation Area | 7 | 1 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dinosaur National Monument | 18 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 20,000 | 20,000 |
| El Malpais National Monument | 28 | 0 | 27 | 6 | 2 | 11 | 38,004 | 4 | 16 | 60,000 | 0 | 0 | 0 | 98,004 |
| Florissant Fossil Beds National Monument | 93 | 0 | 3 | 24 | 3 | 3 | 9,000 | 0 | 0 | 0 | 0 | 0 | 0 | 9,000 |
| Fort Bowie National Historic Site | 32 | 11 | 10 | 6 | 1 | 10 | 10,000 | 0 | 0 | 0 | 0 | 0 | 0 | 10,000 |
| Fort Laramie National Historic Site | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fossil Butte National Monument | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Glacier National Park | 47 | 1 | 25 | 27 | 4 | 6 | 145,000 | 5 | 5 | 65,000 | 11 | 14 | 206,000 | 416,000 |
| Glen Canyon National Recreation Area | 73 | 4 | 1 | 35 | 1 | 1 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 200 |
| Grand Canyon National Park | 72 | 8 | 15 | 38 | 7 | 11 | 96,582 | 4 | 4 | 40,522 | 0 | 0 | 0 | 137,104 |
| Grand Teton National Park | 55 | 0 | 4 | 56 | 1 | 1 | 750 | 1 | 1 | 3,000,000 | 2 | 2 | 701,000 | 3,701,750 |
| Grant-Kohrs Ranch National Historic Site | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Sand Dunes National Park and Preserve | 29 | 13 | 7 | 4 | 3 | 7 | 35,710 | 0 | 0 | 0 | 0 | 0 | 0 | 35,710 |
| Guadalupe Mountains National Park | 23 | 10 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 18,100 | 18,100 |
| John D. Rockefeller, Jr. Memorial Parkway | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lake Meredith National Recreation Area | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| NPS Unit | Features | | | Sites | | | | | | | | | | Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sites and Associated Features Requiring Mitigation | | | | | | | | | |
| | Total | Already Mitigated | Mitigation Required | Total | High | | | Medium | | | Low | | | |
| | # | # | # | # | Sites | Features | Cost ($) | Sites | Features | Cost ($) | Sites | Features | Cost ($) | |
| Organ Pipe Cactus National Monument | 788 | 14 | 408 | 25 | 22 | 405 | 3,591,409 | 0 | 0 | 0 | 3 | 3 | 12,600 | 3,604,009 |
| Padre Island National Seashore | 2 | 0 | 2 | 2 | 1 | 1 | 400,000 | 1 | 1 | 500,000 | 0 | 0 | 0 | 900,000 |
| Pecos National Historic Park | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Petrified Forest National Park | 20 | 3 | 5 | 17 | 2 | 5 | 220,000 | 0 | 0 | 0 | 0 | 0 | 0 | 220,000 |
| Petroglyph National Monument | 3 | 2 | 1 | 3 | 1 | 1 | 40,000 | 0 | 0 | 0 | 0 | 0 | 0 | 40,000 |
| Rocky Mountain National Park | 53 | 0 | 1 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 12,000 | 12,000 |
| Saguaro National Park | 541 | 198 | 127 | 177 | 75 | 122 | 6,454,572 | 3 | 4 | 46,330 | 1 | 1 | 4,000 | 6,504,902 |
| Timpanogos Cave National Monument | 3 | 0 | 3 | 3 | 3 | 3 | 24,000 | 0 | 0 | 0 | 0 | 0 | 0 | 24,000 |
| Tuzigoot National Monument | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| White Sands National Moument | 4 | 0 | 2 | 3 | 2 | 2 | 34,000 | 0 | 0 | 0 | 0 | 0 | 0 | 34,000 |
| Wupatki National Monument | 19 | 0 | 12 | 15 | 0 | 0 | 0 | 1 | 1 | 23,884 | 7 | 11 | 87,300 | 111,184 |
| Yellowstone National Park | 85 | 9 | 69 | 84 | 1 | 1 | 3,000 | 0 | 0 | 0 | 68 | 68 | 359,400 | 362,400 |
| Zion National Park | 28 | 0 | 2 | 27 | 0 | 0 | 0 | 1 | 2 | 16,000 | 0 | 0 | 0 | 16,000 |
| **44 NPS Units - Intermountain Totals** | **2,429** | **407** | **792** | **774** | **146** | **614** | **$13,885,728** | **34** | **60** | **$3,839,216** | **109** | **118** | **$1,740,900** | **$19,465,844** |
| Midwest Region | | | | | | | | | | | | | | |
| Apostle Islands National Lakeshore | 4 | 2 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Badlands National Park | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Buffalo National River | 361 | 6 | 62 | 48 | 5 | 22 | 83,100 | 6 | 11 | 89,550 | 6 | 29 | 218,800 | 391,450 |
| Cuyahoga Valley National Park | 18 | 0 | 15 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 15 | 421,304 | 421,304 |
| Fort Union Trading Post National Historic Site | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| George Washington Carver National Monument | 5 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hopewell Culture National Historic Park | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Indiana Dunes National Lakeshore | 6 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Isle Royale National Park | 36 | 7 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ozark National Scenic Riverways | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pictured Rocks National Lakeshore | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| NPS Unit | Features | | | Sites | | | | | | | | | | Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sites and Associated Features Requiring Mitigation | | | | | | | | | |
| | Total | Already Mitigated | Mitigation Required | Total | High | | | Medium | | | Low | | | |
| | # | # | # | # | Sites | Features | Cost ($) | Sites | Features | Cost ($) | Sites | Features | Cost ($) | |
| Saint Croix National Scenic Riverway | 20 | 2 | 1 | 12 | 0 | 0 | 0 | 1 | 1 | 1,000 | 0 | 0 | 0 | 1,000 |
| Scotts Bluff National Monument | 4 | 0 | 4 | 1 | 0 | 0 | 0 | 1 | 4 | 28,000 | 0 | 0 | 0 | 28,000 |
| Sleeping Bear Dunes National Lakeshore | 15 | 2 | 13 | 9 | 0 | 0 | 0 | 7 | 13 | 103,000 | 0 | 0 | 0 | 103,000 |
| Theodore Roosevelt National Park | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Voyageurs National Park | 20 | 5 | 4 | 15 | 0 | 0 | 0 | 3 | 4 | 17,000 | 0 | 0 | 0 | 17,000 |
| Wilson's Creek National Battlefield | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind Cave National Park | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **18 NPS Units - Midwest Totals** | **505** | **27** | **99** | **136** | **5** | **22** | **$83,100** | **18** | **33** | **$238,550** | **21** | **44** | **$640,104** | **$961,754** |
| National Capital Region | | | | | | | | | | | | | | |
| Chesapeake & Ohio Canal National Historical Park | 38 | 9 | 5 | 3 | 2 | 5 | 32,811 | 0 | 0 | 0 | 0 | 0 | 0 | 32,811 |
| National Capitol Parks - East | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prince William Forest Park | 11 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **3 NPS Units - National Capital Totals** | **53** | **9** | **5** | **8** | **2** | **5** | **$32,811** | **0** | **0** | **$0** | **0** | **0** | **$0** | **$32,811** |
| Northeast Region | | | | | | | | | | | | | | |
| Acadia National Park | 12 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Allegheny Portage Railroad National Historic Site | 28 | 1 | 3 | 6 | 1 | 2 | 16,980 | 1 | 1 | 5,317 | 0 | 0 | 0 | 22,297 |
| Appalachian National Scenic Trail | 5 | 0 | 3 | 1 | 1 | 3 | 41,838 | 0 | 0 | 0 | 0 | 0 | 0 | 41,838 |
| Cape Cod National Seashore | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Colonial National Historical Park | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 30,000 | 30,000 |
| Delaware Water Gap National Recreation Area | 56 | 3 | 3 | 38 | 2 | 3 | 16,188 | 0 | 0 | 0 | 0 | 0 | 0 | 16,188 |
| Fredericksburg and Spotsylvania County Battlefields Memorial National Military Park | 4 | 2 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 7,031 | 7,031 |
| Friendship Hill National Historic Site | 5 | 3 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 510 | 0 | 0 | 0 | 510 |
| Gauley River National Recreation Area | 39 | 0 | 21 | 5 | 5 | 21 | 120,295 | 0 | 0 | 0 | 0 | 0 | 0 | 120,295 |
| New River Gorge National River | 696 | 124 | 105 | 122 | 39 | 92 | 705,240 | 10 | 13 | 39,961 | 0 | 0 | 0 | 745,201 |

| NPS Unit | Features | | | Sites | | | | | | | | | | Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sites and Associated Features Requiring Mitigation | | | | | | | | | |
| | Total | Already Mitigated | Mitigation Required | Total | High | | | Medium | | | Low | | | |
| | # | # | # | # | Sites | Features | Cost ($) | Sites | Features | Cost ($) | Sites | Features | Cost ($) | |
| Richmond National Battlefield Park | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Saratoga National Historical Park | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shenandoah National Park | 27 | 2 | 8 | 17 | 0 | 0 | 0 | 4 | 5 | 85,454 | 2 | 3 | 20,105 | 105,559 |
| Steamtown National Historic Site | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Valley Forge National Historical Park | 9 | 2 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| **15 NPS Units - Northeast Totals** | **887** | **137** | **147** | **220** | **48** | **121** | **$900,541** | **16** | **20** | **$131,242** | **5** | **6** | **$57,136** | **$1,088,919** |
| Pacific West Region | | | | | | | | | | | | | | |
| City of Rocks National Reserve | 15 | 4 | 2 | 8 | 0 | 0 | 0 | 2 | 2 | 16,948 | 0 | 0 | 0 | 16,948 |
| Crater Lake National Park | 15 | 0 | 5 | 15 | 0 | 0 | 0 | 5 | 5 | 23,306 | 0 | 0 | 0 | 23,306 |
| Craters of the Moon National Monument and Preserve | 53 | 43 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Death Valley National Park | 9,250 | 54 | 809 | 201 | 146 | 802 | 11,205,312 | 1 | 4 | 0 | 2 | 3 | 0 | 11,205,312 |
| Golden Gate National Recreation Area | 11 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Basin National Park | 281 | 38 | 93 | 15 | 5 | 69 | 609,500 | 3 | 23 | 486,500 | 1 | 1 | 12,000 | 1,108,000 |
| Joshua Tree National Park | 531 | 20 | 58 | 64 | 23 | 53 | 311,100 | 3 | 4 | 0 | 1 | 1 | 200 | 311,300 |
| Lake Chelan National Recreation Area | 8 | 2 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lake Mead National Recreation Area | 1,102 | 74 | 146 | 419 | 44 | 81 | 947,187 | 20 | 28 | 211,600 | 30 | 37 | 697,901 | 1,856,688 |
| Lassen Volcanic National Park | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lava Beds National Monument | 10 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mojave National Preserve | 6,460 | 302 | 537 | 253 | 131 | 534 | 6,425,588 | 3 | 3 | 0 | 0 | 0 | 0 | 6,425,588 |
| Mount Rainier National Park | 48 | 2 | 5 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 6,000 | 6,000 |
| North Cascades National Park | 73 | 2 | 13 | 38 | 5 | 9 | 110,256 | 3 | 4 | 43,922 | 0 | 0 | 0 | 154,178 |
| Olympic National Park | 25 | 0 | 7 | 13 | 1 | 2 | 7,638 | 2 | 5 | 14,583 | 0 | 0 | 0 | 22,221 |
| Parashant National Monument | 12 | 12 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Point Reyes National Seashore | 57 | 0 | 3 | 3 | 2 | 3 | 19,000 | 0 | 0 | 0 | 0 | 0 | 0 | 19,000 |
| Puukohola Heiau National Historic Site | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Redwood National Park | 7 | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ross Lake National Recreation Area | 21 | 2 | 1 | 11 | 1 | 1 | 3,732 | 0 | 0 | 0 | 0 | 0 | 0 | 3,732 |

| NPS Unit | Features | | | Sites | | | | | | | | | | Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sites and Associated Features Requiring Mitigation | | | | | | | | | |
| | | | | | High | | | Medium | | | Low | | | |
| | Total | Already Mitigated | Mitigation Required | Total | Sites | Features | Cost ($) | Sites | Features | Cost ($) | Sites | Features | Cost ($) | |
| | # | # | # | # | | | | | | | | | | |
| Sequoia & Kings Canyon National Parks | 137 | 0 | 20 | 12 | 8 | 20 | 163,000 | 0 | 0 | 0 | 0 | 0 | 0 | 163,000 |
| Whiskeytown-Shasta-Trinity National Recreation Area | 102 | 20 | 12 | 23 | 10 | 12 | 70,000 | 0 | 0 | 0 | 0 | 0 | 0 | 70,000 |
| Yosemite National Park | 64 | 2 | 7 | 5 | 3 | 7 | 71,000 | 0 | 0 | 0 | 0 | 0 | 0 | 71,000 |
| **23 NPS Units - Pacific West Totals** | **18,284** | **581** | **1,718** | **1,140** | **379** | **1,593** | **$19,943,313** | **42** | **78** | **$796,859** | **36** | **47** | **$716,101** | **$21,456,273** |
| Southeast Region | | | | | | | | | | | | | | |
| Big Cypress National Preserve | 91 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big South Fork National River & Recreation Area | 144 | 48 | 34 | 40 | 10 | 21 | 3,448,001 | 13 | 13 | 432,127 | 0 | 0 | 0 | 3,880,128 |
| Chickamauga & Chattanooga National Military Park | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cumberland Gap National Historical Park | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Everglades National Park | 17 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Smoky Mountains National Park | 21 | 4 | 11 | 2 | 2 | 11 | 115,747 | 0 | 0 | 0 | 0 | 0 | 0 | 115,747 |
| Horseshoe Bend National Military Park | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jean Lafitte National Historical Park and Preserve | 11 | 7 | 4 | 8 | 4 | 4 | 95,244 | 0 | 0 | 0 | 0 | 0 | 0 | 95,244 |
| Kings Mountain National Military Park | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mammoth Cave National Park | 16 | 9 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Natchez Trace Parkway | 4 | 0 | 1 | 4 | 0 | 0 | 0 | 1 | 1 | 1,845 | 0 | 0 | 0 | 1,845 |
| Obed Wild & Scenic River | 3 | 0 | 2 | 2 | 1 | 2 | 31,432 | 0 | 0 | 0 | 0 | 0 | 0 | 31,432 |
| Russell Cave National Monument | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **13 NPS Units - Southeast Region Totals** | **315** | **72** | **52** | **112** | **17** | **38** | **$3,690,424** | **14** | **14** | **$433,972** | **0** | **0** | **$0** | **$4,124,396** |
| **129 NPS Units - System- Wide Totals** | **23,182** | **1,341** | **2,869** | **2,646** | **626** | **2,435** | **$44,878,387** | **133** | **218** | **$7,498,120** | **172** | **216** | **$3,186,261** | **$55,562,768** |

(Detailed data reside in the Service-wide AML database. Custom data reports can be generated according to specific region and park needs.)

# Appendix D: NPS standard construction approach to estimating AML mitigation costs

## NATIONAL PARK SERVICE – DENVER SERVICE CENTER
## ABANDONED MINERAL LANDS INVENTORY AND ASSESSMENT

### *Overview*

The intent of this document is to present the standard construction cost estimating approaches that are used for the Eastern, Pacific West, and other regions of the National Park Service for the generation of mitigation costs associated with Abandoned Mineral Land (AML) sites and features located in National Park Service units.

### *Cost Elements to Include and Associated Percentages*

Class C estimates represent costs for a project without having the scope of work fully defined. The generally accepted industry accuracy range of Class C Construction Cost Estimates is -30% to +50%.

The cost estimate for mitigation options shown in the AML database should contain the following direct cost elements of a Class C cost estimate. These direct costs assume that work will be contracted and not completed with park or volunteer resources.

- Labor – Actual estimated costs for labor
- Equipment – Actual estimated costs for equipment (operator costs not included with these costs)
- Materials – Actual estimated costs for materials
- Travel cost for remote or off-road features

The following markups should also be included with the mitigation cost Class C estimates:

- Location adjustments (location factors, remoteness, Davis-Bacon wage rates specific to location): 0–20% depending on location
- General conditions (standard and government): 20%
- Historic preservation factor: 5% if applicable, otherwise use zero
- Overhead: 10%
- Profit: 10%
- Contracting method adjustment: 15%
- Construction management: 8%
- Contingency (design and construction): 10%
- Compliance: 5% or more
-

The NPS Service-wide AML database assesses costs on an individual feature basis. Undoubtedly, construction efficiencies will be realized by bundling multiple features into each mine closure project, which will lower the costs per feature represented here. Construction efficiencies vary based on such things as size of the project budget, proximity of the features from one another, and the type of work to be performed. No attempt has been made to estimate an average construction efficiency factor, but cost savings will be realized on larger projects. The individual feature costs in this analysis therefore constitute a high-end cost estimate.

All costs are in FY 2012 dollars. Markups shall be applied in the following order:

$1,000 is used as an example direct cost.

**Table D-1. AML cost estimating mark-ups**

| Line | Cost Type | Calculation | Total |
|---|---|---|---|
| A | Direct costs (labor, equipment, material) | Actual estimated costs | $1,000.00 |
| B | Location Adjustment | Direct Costs x 0.10 | $100.00 |
| **C** | **SUBTOTAL** | **Sum of Lines A and B** | **$1,100.00** |
| D | General Conditions | Line C x 0.20 | $220.00 |
| E | Historic Preservation* | Line C x 0.00 | $0.00 |
| **F** | **SUBTOTAL** | **Sum of Lines C, D, and E** | **$1,320.00** |
| G | Bond | Line F x 0.01 | $13.20 |
| **H** | **SUBTOTAL** | **Sum of Lines F and G** | **$1,333.20** |
| I | Overhead | Line H x 0.10 | $133.32 |
| J | Profit | Line H x 0.10 | $133.32 |
| **K** | **SUBTOTAL** | **Sum of Lines H, I, and J** | **$1,599.84** |
| L | Contracting Method Adjustment | Line K x 0.15 | $239.98 |
| **M** | **SUBTOTAL** | **Sum of Lines K and L** | **$1,839.82** |
| N | Construction Management | Line M x 0.08 | $147.19 |
| O | Contingency (Design and Construction) | Line M x 0.10 | $183.98 |
| **P** | **TOTAL ESTIMATE FOR MITIGATION** | **Sum of Lines M, N, and O** | **$2,170.99** |

* Historic preservation costs should only be included when applicable

Compliance is a separate overall program funding request. Because the percentage would vary depending on approach and needs of a region, it is listed separately rather than as a fixed number in the chart.

### *Cost Elements to Exclude*

- Inflation escalation
- Assumptions about government furnished materials
- Builder's risk insurance/performance bond
- Cost savings resulting from the mitigation of multiple features within a single contract. At this time, there is no way to know how funding will be allocated for mitigation.

### *Estimating Resources*

The following resources are recommended for development of mitigation cost estimates:

- National Park Service Cost Estimating Requirements Handbook available at http://www.nps.gov/dscw/upload/CostEstimatingHandbook_2-3-11.pdf.
- RSMeans and other construction commercial cost indices. [10]
- Historical data for AML mitigation (ARRA projects, in-house, other contracted, etc.), which are kept by the Denver Service Center, Geologic Resources Division, and the parks and regions that have completed this work. All this information should be recorded in the Service-wide AML database.

[10] http://rsmeans.reedconstructiondata.com/?CouponCode=IGOG2001&gclid=CPfiyJKYu7MCFcRU4Aodg2kAog

*Definitions*

The following definitions can be found in the NPS Cost Estimating Requirements Handbook.

**Bonds** – A form of security guaranteeing fulfillment of some obligation. In the construction industry, bonds are typically provided by surety companies to project owners. If the contractor does not perform according to the terms of the bond, the surety company will pay the project owner the amount specified by the bond.

**Compliance Costs** – Costs necessary to finance special studies such as Environmental Assessments or other studies/surveys necessary to be complete prior to construction activities.

**Construction Management Costs** – Costs associated with project management and monitoring of the project. These costs may include any special inspections required during construction.

**Contingency** (design and construction) – Costs associated with unknowns in the project.

**Contracting Method Adjustment** – A majority of the construction contracting for the National Park Service is not performed using typical low bid procurement processes. As a result, there is a limitation on competition for most projects, which tends to have an upward impact on project costs. The primary procurement method used by NPS is competitive negotiation where award is based on negotiating a price with the most technically qualified contractor. This method may typically add 5% or more to the cost of contracting over the lowest-price, competitive bid procurement processes. The NPS also awards many contracts through the Small Business Administration's 8(a), Service Disabled Veteran, and Hub-Zone programs. These awards may be made on either on a limited competitive or sole source negotiated basis. Depending on the procurement method chosen, costs can be affected 10–15% or more.

**Equipment** – Costs associated with operating owned or rented equipment used for construction activities. Mitigation of abandoned mineral land sites/features typically involves some or all of the following: welding machines, backhoe, front-end loader, pickup truck, trailers, generators, helicopters, and pumps. Hand tools (shovels, picks, drills, etc.) are not typically included with equipment costs.

**Federal Wage Rate Factor** (labor only) – Costs used to adjust the labor costs of an estimate to reflect the difference between the location factor, adjusted labor data used to prepare an estimate, and the federally mandated Davis-Bacon Act labor rates in effect for the project location.

**General Conditions** – A set of guidelines that defines many of the rights, responsibilities, and limitations of authority of the owner and contractor, and includes the general procedures governing the performance of the work.

**Standard General Conditions** – These are the project indirect costs incurred by the contractor that are typically defined in the Division 1 specifications for a project. The costs associated with temporary utilities, field offices, fencing, field engineering, operation and maintenance manuals, etc., are all included as standard general conditions. Also included in the General Conditions percentage should be the cost of construction permits, bonds, and insurance.

**Government General Conditions** – These costs, which are not included in the Standard General Conditions, are the costs of doing work for the United States government and the National Park Service. Many of these government costs are attributable to the increased administrative requirements and quality requirements, along with sensitivity to the NPS mission of protecting the cultural and natural resources while allowing the public access and enjoyment thereof.

**Historic Preservation Factor** – Many projects within the National Park Service involve work in and around historical structures or cultural landscapes. It is part of the National Park Service's mission to preserve and maintain the integrity of the original architectural construction, histori-

cal fabric, and cultural appearance of the assets at or near the proposed work. This requirement often creates additional access control issues, protection process requirements, and coordination problems during construction, which lead to additional cost impacts to a project. In some cases, material costs increase significantly because of the need to select compatible materials. The range for this factor can vary significantly, and considerable judgment is required to formulate an appropriate factor. The rationale and justification for the Historic Preservation Factor should be well documented in the Basis of Estimate Statement.

**Inflation Escalation** – Independent government and architectural/engineering company (A/E) estimates are generally prepared well in advance of contract procurement. Therefore, some sort of factor needs to be applied to an estimate's total cost to account for a changing market over time. All direct unit costs within the estimates should be priced using current (date of estimate) costs. An adjustment for inflation is then added to the bottom line total of the estimate. This escalation must be based on a careful analysis of current market trends and published construction economics predictions. Escalation should be dated to the proposed mid-point of construction. If historical costs from the park or project location are used to develop the direct costs, it may be necessary to escalate the costs from the time in which they were incurred to present values first, and then escalate them to the mid-point of construction.

**Labor** – Labor costs include the cost for equipment operators, laborers, welders, supervisors, and others to complete the scope of work. This does not include overhead labor. Overhead labor is included with the overhead markup.

**Location Factor** – This factor adjusts generic national average cost data to regional or local construction market pricing for labor, material, and/or equipment. If using a local cost database rather than national data, a location factor adjustment will not be required.

**Materials** – Mitigation of abandoned mineral land sites/features may require the use of metal, concrete, PUF, wood, hardware, fencing, soil stabilization, and/or explosives. Material costs include costs for all materials necessary to complete the scope of work.

**Overhead** – The cost that a contractor has for staying in business. A general contractor has expenses not directly related to the construction of a project but vital to the contractor's business operations. These include fixed overhead (federal and state unemployment costs, Social Security tax, builder's risk insurance, and public liability costs) and variable overhead (Worker's Compensation insurance, office overhead, etc.).

**Profit** – The cost or fee that a contractor charges to provide a return on their investment and to compensate them for assuming risk on a project. The amount of profit charged is highly variable and dependent on a number of factors, including local market conditions, the size of job, the amount of risk associated with the work, the contractor's total work volume, and the company size. Contractors generally take more profit on a smaller job. One factor often overlooked in preparing independent government estimates and A/E estimates is that not only is the general contractor entitled to compensation for overhead and profit, but so are any subcontractors or independent installers that they employ to perform the work. Some cost databases include installer overhead and profit in a separate column.

**Remoteness Factor** –A majority of NPS park units are not located in one of the nearly 700 cities listed in the RSMeans City Cost Index or in similar indexes. They are remotely located away from significant source areas of labor pools, material vendors, and equipment suppliers. Because of the remote nature of most national parks, an adjustment typically needs to be made for mobilization/demobilization, labor pool per diem, compensated commute times, and shipping costs of materials, as well as less tangible impacts of managing remote operations. If labor, equipment, and materials can be delivered to the project site by over-the-road transportation, we generally use a remoteness factor of 1% for each 10 miles that the project is located away from the commercial center used in determining the location factor. Considerations should also be made for sites that are difficult to access (e.g., unimproved roads, backcountry areas, or where water or aerial access

is required). If a project site is significantly remote from normal vehicle transportation access, some attempt should be made to estimate the direct transport costs (pack teams, boat/barge, off road vehicles, or helicopters), or estimators can add an allowance cost or other percentage allowance based on their best estimating judgment or professional experience.

**State and Local Taxes** – Construction contractors for the National Park Service are required to pay local and state taxes on material and rental equipment used on the project. Most find the paperwork for exemption cumbersome and simply pass the taxes along to the government.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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